COCODRIE LAKE TMDL FOR CHLORIDE, SULFATE, AND SALINITY/TOTAL DISSOLVED SOLIDS (TDS)

SUBSEGMENT 060102

US EPA Region 6

Final

May 3, 2001

TABLE OF CONTENTS

LIST OF TABLES

EXECUTIVE SUMMARY

Section 303(d) of the Federal Clean Water Act requires states to identify waterbodies that are not meeting water quality standards and to develop total maximum daily pollutant loads for those waterbodies. A total maximum daily load (TMDL) is the amount of a pollutant that a waterbody can assimilate without exceeding the established water quality standard for that pollutant. Through a TMDL, pollutant loads can be distributed or allocated to point sources and nonpoint sources discharging to the waterbody. A TMDL has been developed for chloride, sulfate, and salinity/total dissolved solids (TDS) for Cocodrie Lake. Throughout the rest of this document, the term TDS will be used to signify also salinity.

Cocodrie Lake, subsegment 060102, is located in southern Louisiana in the Vermilion-Teche River Basin between Alexandria and Lafayette. Cocodrie Lake was not listed on the 1998 or October 28, 1999 Court Ordered §303(d) Lists, but was listed on the Consent Order. However, based on subsequent data reviews by EPA, it was determined that this subsegment is fully supporting the water quality standard for chloride and sulfate. There is no water quality data for TDS. Although this subsegment is meeting water quality standards for chloride, sulfate, and TDS, a TMDL was developed to comply with the Consent Order. Louisiana's water quality standards for chloride, sulfate, and TDS are applied as follows:

"Numerical criteria for these parameters generally represent the arithmetic mean of existing data from the nearest sampling location plus three standard deviations. For estuarine and coastal marine waters subsegments in Table 3 that have no listed criteria (i.e., designated N/A), criteria will be established on a case-by-case basis using field determination of ambient conditions and the designated uses. For water bodies not specifically listed in the Numerical Criteria and Designated Table, increases over background levels of chloride, sulfate, and TDS may be permitted. Such increases will be permitted at the discretion of the office on a case-by-case basis and shall not cause in-stream concentrations to exceed 250, 250, and 500 mg/l for chloride, sulfate, and TDS, respectively, except where a use attainability analysis indicates that higher levels will not affect the designated uses. In permitting such increases, the office shall consider their potential effects on resident biota and downstream water bodies in addition to the background conditions. Under no circumstances shall an allowed increase over background conditions cause any numerical criteria to be exceeded in any listed water body or any other general or numerical criteria to be exceeded in either listed or unlisted water bodies."

LDEQ monitoring data was assessed for Cocodrie Lake, subsegment 060102, to determine if the propagation of fish and wildlife use was being maintained. Analysis of the data shows that the propagation of fish and wildlife use is protected. Less than 30% of the measurements for chlorides, sulfates, and TDS exceeded the respective criteria of 10 mg/l, 5 mg/l, and 100mg/l (see Appendix A). For the purpose of calculating current chloride, sulfate, and TDS loads on subsegment 060102, the average chloride, sulfate, and TDS concentrations were averaged using monitoring data (or estimated data for TDS) from LDEQ station 0663. In subsegment 060102, average chloride, sulfate, and TDS concentrations were 5.77 mg/l, 2.21 mg/l, and 48.69 mg/l, respectively, over the collection period (June 17, 1998 - December 2, 1998).

For the purpose of TMDL development, the State criteria of 10 mg/l, 5 mg/l, and 100 mg/l for chloride, sulfate, and TDS, respectively, were applied. These chloride, sulfate, and TDS TMDLs were developed based on simple dilution calculations using average flow and the State standards. The TMDL calculation includes a wasteload allocation, a load allocation, and a margin of safety. It was found that subsegment 060102 could carry an additional chloride, sulfate, and TDS load

of 8073.76 lb/day, 5325.29 lb/day, and 97935.68 lb/day, respectively, before exceeding TMDL limits for the subsegment. Thus, 0% reductions of chloride, sulfate, and TDS loads will meet the Louisiana chloride, sulfate, and TDS standards for the propagation of fish and wildlife.

1. Introduction

Cocodrie Lake, subsegment 060102, was not listed on the 1998 or October 28, 1999 Court Ordered §303(d) Lists but was listed on the Consent Order. Based on subsequent data reviews by EPA, it was determined that the subsegment is fully supporting the water quality standards for the propagation of fish and wildlife. TMDLs for chloride, sulfate, and salinity/total dissolved solids (TDS) were developed to comply with the Consent Order. The purpose of a TMDL is to determine the pollutant loading that a waterbody can assimilate without exceeding the water quality standard for that pollutant; the TMDL also establishes the load reduction that is necessary to meet the standard in a waterbody. The TMDL consists of the wasteload allocation (WLA), the load allocation (LA), and a margin of safety (MOS). The wasteload allocation is the load allocated to point sources for the pollutant of concern, and the load allocation is the load allocated to nonpoint sources. The margin of safety is a percentage of the TMDL that accounts for the uncertainty associated with the model assumptions and data inadequacies.

2. Study Area Description

2.1 Cocodrie Lake, Subsegment 060102

Water quality segment 060102 is located in southern Louisiana in the Vermilion-Teche River Basin between Alexandria and Lafayette. The basin is bordered on the north and northeast by a low escarpment and the lower end of the Red River Basin. The Atchafalaya River Basin is to the east, and the Mermentau River Basin is to the west (LDEQ, 1996).

Land use in the Vermilion-Teche Basin is largely forestry and agriculture. In the segment under study, land use is predominantly forestry accounting for 80.3% of the total segment area. Land use in the watershed is summarized in Table 1.

Table 1. Land Uses in WQ Segments 0601 (Upstream of Cocodrie Dam).
Source: LDEQ (1993)

	% of Total Area
Land Use Type	Segment 0601
Urban	1.4
Extractive	0.0
Agricultural	9.4
Forest Land	80.3
Water	0.2
Wetland	6.2
Barren land	2.5
Other	0.0
TOTAL	100

Cocodrie Lake is a shallow lake that is mostly covered with timber. Inflows to Cocodrie Lake include the upper part of Bayou Cocodrie, Spring Creek, Little Spring Creek, and Hurricane Creek. The total drainage area of Cocodrie Lake is approximately 227 square miles (USGS, 1971). The outlet of Cocodrie Lake consists of an uncontrolled overflow spillway across the channel of Bayou Cocodrie near Highway 167. The lake can be drawn down below the spillway level via a bypass valve and a control.

2.2 Water Quality Standards

The designated uses for Cocodrie Lake include primary contact recreation, secondary contact recreation, and propagation of fish and wildlife. Chloride, sulfate, and TDS are the water quality indicators used in the assessment of use support. Louisiana's water quality criteria for chloride, sulfate, and TDS are 10 mg/l, 5 mg/l, and 100 mg/l, respectively.

2.3 Identification of Sources

The sources identified in the *1998 Louisiana Water Quality Inventory* as affecting the water quality of Bayou Cocodrie are designated as "Other" (natural sources) (LDEQ, 1998).

2.3.1 Point Sources

There are no direct point sources dischargers to the Cocodrie Lake. However, there are two point source dischargers located on the tributaries flowing into Cocodrie Lake. These two permitted facilities with known flow information and discharging sanitary wastewater into the tributaries flowing into Cocodrie Lake are shown in Appendix B.

2.3.2 Nonpoint Sources

Nonpoint sources of these constituents have not been sufficiently studied to provide more than a generic load allocation.

3. TMDL Load Calculations

3.1 Current Load Evaluation

Chloride, sulfate, and TDS loads have been calculated using the instream chloride and sulfate concentrations and estimated TDS concentrations, and the average flow of the stream. The following equation can be used to calculate chloride, sulfate, TDS loads.

Equation 1. C x Q in cfs x 5.39 lb/day or C x Q in MGD x 8.34 lb/day

Where: C = concentration in mg/l and Q = stream flow in cfs or MGD

A traditional expression of loads may be developed by setting one critical or representative flow and concentration, and calculating the chloride, sulfate, and TDS loads using Equation 1. The difficulty with this approach is in the determination of the appropriate flow or concentration value to use.

For the purpose of calculating current chloride and sulfate loading on segment 060102, the average chloride and sulfate concentrations were calculated using monitoring data from LDEQ station 0663. In subsegment 060102, average chloride and sulfate concentrations were 5.77 mg/l and 2.21 mg/l, respectively, over the collection period (June 17, 1998 - December 2, 1998). Only one of twelve values for chlorides or sulfates was greater than the criterion.

TDS data were not available and were therefore estimated. TDS can be estimated by multiplying conductivity values by a multiplier. For the analyses of natural waters, the multiplier ranges from 0.55 to 0.96 (mg/l/μmho), the higher values generally being associated with waters high in sulfate concentrations (Hem, 1985). For this data set, 0.75 mg/l/ μmho was used as the multiplier because sulfate concentrations are low. The calculated value from monitoring data in other waters in Louisiana with high sulfates was 1.02 mg/l/ μmho. The average TDS concentration was estimated as 48.69 mg/l. None of the estimated values exceeded the TDS criterion of 100 mg/l (see Appendix A). However, a TMDL was developed to comply with the Consent Order.

Average stream flow was calculated based on the runoff for USGS station on Bayou Courtableau near Washington, LA with a runoff rate of 1.56 cfs per square mile and a total drainage area of 227.00 square miles. The average stream flow was calculated to be 354.12 cfs.

Using these values and Equation 1, it is estimated that the current loads for chloride, sulfate, and TDS are:

Current load for chloride = 5.77 mg/l x 354.12 cfs x 5.39 lb/day = 11,013.24 lb/day

Current load for sulfate = 2.21 mg/l x 354.12 cfs x 5.39 lb/day = 4,218.24 lb/day

Current load for TDS = 48.69 mg/l x 354.12 cfs x 5.39 lb/day = 92,935.00 lb/day

3.2 TMDL

The load reduction needed to meet the water quality standard for propagation of fish and wildlife in Cocodrie Lake is 0.00 lb/day (0% reduction). This was obtained by calculating the allowable TMDL at 354.12 cfs for the 10 mg/l, 5 mg/l, and 100mg/L criterion for chloride, sulfate, and TDS, respectively (19,087.00 lb/day for chloride; 9,543.53 lb/day for sulfate; and 190,870.68 lb/day for TDS) and subtracting these loads from the observed (or estimated) loads (11,013.24 lb/day for chloride; 4,218.24 lb/day for sulfate; and 92,935.00 lb/day for TDS). However, since the observed (or estimated) loads were less than the allowable loads, no load reduction is required.

TMDL for chloride = Cstd x Q cfs x 5.39 lb/day, where Cstd= 10 mg/l, Q=354.12 cfs

TMDL for chloride = 10 mg/l x 354.12 cfs x 5.39lb/day = 19,087.00 lb/day

Current Load - TMDL = Load Reduction for Chloride

11,013.24 lb/day – 19,087.00 lb/day = 0.00 lb/day

Similarly for sulfate:

TMDL for sulfate = Cstd x Q cfs x 5.39 lb/day, where Cstd= 5 mg/l, Q=354.12 cfs

TMDL for sulfate = 5 mg/l x 354.12 cfs x 5.39lb/day = 9,543.53 lb/day

Current Load - TMDL = Load Reduction for sulfate

4,218.24 lb/day – 9,543.53 lb/day = 0.00 lb/day

Similarly for TDS:

TMDL for TDS = Cstd x Q cfs x 5.39 lb/day, where Cstd= 100 mg/l, Q=354.12 cfs

TMDL for TDS = 100 mg/l x 354.12 cfs x 5.39lb/day = 190,870.68 lb/day

Current Load - TMDL = Load Reduction for TDS

92,935.00 lb/day - 190,870.68 lb/day = 0.00 lb/day

3.3 Wasteload Allocation (WLA)

The Louisiana Water Quality Regulations require permitted point source discharges of treated sanitary wastewater to maintain in-stream chloride, sulfate, and TDS water quality standards of 10 mg/l, 5 mg/l, and 100 mg/l, respectively, on this subsegment. Therefore, there may be a need to include chloride, sulfate, and TDS limits as the permit requirement based upon a wasteload allocation resulting from this TMDL.

Equation 1 can be used to calculate the total point source load (wasteload allocation) utilizing the water quality criteria for chloride, sulfate, and TDS of 10 mg/l, 5 mg/l, and 100 mg/l, respectively, and the design flow of all the wastewater dischargers (0.302 million gallons/day). For chloride, sulfate, and TDS:

Cstd mg/l * Q in MGD * 8.34 = WLA lb/day

Where, Cstd is the water quality standard and Q is the discharge design flow from permitted facilities in subsegment 060102 thus:

WLA for chloride = 10 mg/l x 0.302 MGD x 8.34 = 25.19 lb/day

WLA for sulfate = 5 mg/l x 0.302 MGD x 8.34 = 12.59 lb/day

WLA for TDS = 100 mg/l x 0.302 MGD x 8.34 = 251.90 lb/day

3.4 Load Allocation (LA)

The load allocation for a given flow can be calculated using Equation 1 and the following relationship:

(TMDL@ given flow and criterion) - (WLA) = LA

LA for chloride at instream flow of 354.12 cfs = 19,061.81 lb/day

19,087.00 lb/day (TMDL@ 354.12 cfs) – 25.19 lb/day (WLA) = 19,061.81 lb/day

LA for sulfate at instream flow of 354.12 cfs = 9,530.94 lb/day

9,543.53 lb/day (TMDL@ 354.12 cfs) – 12.59 lb/day (WLA) = 9,530.94 lb/day

LA for TDS at instream flow of 354.12 cfs = 190,618.78 lb/day

190,870.68 lb/day (TMDL@ 354.12 cfs) – 251.90 lb/day (WLA) = 190,618.78 lb/day

3.5 Seasonal Variability

Louisiana's water quality standards for chloride, sulfate, and TDS are for January through December. Therefore, no seasonal TMDLs for chloride, sulfate, or TDS was developed.

3.6 Margin of Safety (MOS)

The Clean Water Act requires that TMDLs take into consideration a margin of safety. EPA guidance allows for the use of implicit or explicit expressions of the margin of safety or both. When conservative assumptions are used in the development of the TMDL or conservative factors are used in the calculations, the margin of safety is implicit. When a percentage of the load is factored into the TMDL calculation as a margin of safety, the margin of safety is explicit. In this TMDL for TDS, conservative assumptions have been used and therefore, the margin of safety is implicit. These conservative assumptions are:

- Using average flows to calculate current loading to obtain load reduction.
- Treating chloride, sulfate, and TDS as conservative pollutants, which means that these pollutants do not degrade in the environment.

- Using the chloride, sulfate, and TDS water quality standards of 10 mg/l, 5 mg/l, and 100 mg/l rather than using site-specific criteria and seasonal variability factors.
- Using the design flow of the point source dischargers rather than actual average flow rates, which are typically much lower

4. Other Relevant Information

Although not required by this TMDL, LDEQ utilizes funds under Section 106 of the federal Clean Water Act and under the authority of the Louisiana Environmental Quality Act to operate an established program for monitoring the quality of the state's surface waters. The LDEQ Surveillance Section collects surface water samples at various locations, utilizing appropriate sampling methods and procedures for ensuring the quality of the data collected. The objectives of the surface-water monitoring program are to determine the quality of the state's surface waters, to develop a long-term database for water quality trend analysis, and to monitor the effectiveness of pollution controls. The data obtained through the surface-water monitoring program is used to develop the state's biennial 305(b) report (*Water Quality Inventory*) and the 303(d) list of impaired waters. This information is also utilized in establishing priorities for the LDEQ nonpoint source program.

The LDEQ has implemented a watershed approach to surface water quality monitoring. Through this approach, the entire state is sampled over a five-year cycle with two targeted basins sampled each year. Long-term trend monitoring sites at various locations on the larger rivers and Lake Pontchartrain are sampled throughout the five-year cycle. Sampling is conducted on a monthly basis or more frequently if necessary to yield at least 12 samples per site each year. Sampling sites are located where they are considered to be representative of the waterbody. Under the current monitoring schedule, targeted basins follow the TMDL priorities. In this manner, the first TMDLs will have been established by the time the first priority basins are monitored again in the second five-year cycle. This will allow the LDEQ to determine whether there has been any improvement in water quality following establishment of the TMDLs. As the monitoring results are evaluated at the end of each year, waterbodies may be added to or removed from the 303(d) list. The sampling schedule for the first five-year cycle is shown below. The Vermilion-Teche River Basin will be sampled again in 2003.

1998 – Mermentau and Vermilion-Teche River Basins
1999 - Calcasieu and Ouachita River Basins
2000 – Barataria and Terrebonne Basins
2001 – Lake Pontchartrain Basin and Pearl River Basin
2002 – Red and Sabine River Basins

(Atchafalaya and Mississippi Rivers will be sampled continuously.)

In addition to ambient water quality sampling in the priority basins, the LDEQ has increased compliance monitoring in those basins, following the same schedule. Approximately 1,000 to 1,100 permitted facilities in the priority basins were targeted for inspections. The goal set by LDEQ was to inspect all of those facilities on the list and to sample 1/3 of the minors and 1/3 of

the majors. During 1998, 476 compliance evaluation inspections and 165 compliance-sampling inspections were conducted throughout the Mermentau and Vermilion-Teche River Basins.

5. Public Participation

When EPA establishes a TMDL, 40 C.F.R. § 130.7(d)(2) requires EPA to publicly notice and seek comment concerning the TMDL. Pursuant to an October 1, 1999, Court Order, EPA prepared this TMDL. After submission of this TMDL to the Court, EPA commenced preparation of a notice seeking comments, information and data from the general and affected public. Comments and additional information were submitted during the public comment period and this Court Ordered TMDL was revised accordingly. EPA has transmitted this revised TMDL to the Court, and to the Louisiana Department of Environmental Quality (LDEQ) for incorporation into LDEQ's current water quality management plan.

REFERENCES

Hem, John D. 1985. Study and Interpretation of the Chemical Characteristics of Natural Water. Third Edition. United States Geological Survey Water-Supply Paper 2254. U.S. Government Printing Office.

Louisiana Department of Environmental Quality. 1993. *State of Louisiana Water Quality Management Plan, Volume 6, Part A: Nonpoint Source Pollution Assessment Report*. Louisiana Department of Environmental Quality, Office of Water Resources, Baton Rouge.

Louisiana Department of Environmental Quality. 1996. *State of Louisiana Water Quality Management Plan, Volume 5, Part B: Water Quality Inventory*. Louisiana Department of Environmental Quality, Office of Water Resources, Baton Rouge.

Louisiana Department of Environmental Quality. 1998. *State of Louisiana Water Quality Management Plan, Volume 5, Part B: Water Quality Inventory*. Louisiana Department of Environmental Quality, Office of Water Resources, Baton Rouge.

USGS. 1971. Drainage Area of Louisiana Streams. Basic Records Report No. 6. Prepared by US Geological Survey in cooperation with Louisiana Department of Transportation and Development, Baton Rouge, LA: 1971 (Reprinted 1991).

APPENDIX A. Chloride, Sulfate, Conductivity, and Total Dissolved Solids (TDS) data.

All chloride, sulfate, and field conductivity data collected at Cocodrie Lake over the specified period of record can be found on the Louisiana Department of Environmental Quality's web site at:

http://www.deq.state.la.us/surveillance/wqdata/0663wqng.txt.

Date	Chloride Mg/l	Sulfate mg/l	Field Conductivity Umhos	Estimated TDS* mg/L
12/2/98	5.5	1.3	89.0	66.75
11/18/98	3.6	3.9	75.0	56.25
11/5/98	6.0	<1.3	81.0	60.75
10/21/98	5.3	<1.3	88.0	66.00
10/7/98	4.3	<2.0	58.0	43.50
9/28/98	4.2	2.3	62.0	46.50
9/2/98	12.2	6.4	50.0	37.50
8/19/98	5.4	1.3	56.0	42.00
8/5/98	5.7	<1.3	50.0	37.50
7/22/98	5.9	2.8	57.0	42.75
7/8/98	5.5	<1.3	59.0	44.25
6/17/98	5.6	<1.3	54.0	40.50

* Estimated TDS by multiplying field conductivity by 0.75. (Hem, 1986)
Note: The 10 mg/L and 5 mg/l criteria for chloride and sulfate, respectively, were exceeded in 1 out of 12 sampling events. No single value was above the 100 mg/l criterion for TDS.

APPENDIX B Dischargers in subsegment 060102

Dischargers to tributaries then into Cocodrie Lake			
Facility	Permit #	Receiving Water	Design Flow
Village of Forest Hill	LAG570142	Hurricane Ck, then to Cocodrie Lake	0.074 MGD
City of Glenmora	LA0054925	Little Spring Ck, then to Cocodrie lake	0.228 MGD

Total Design Flow: 0.302 MGD